Predictive Tool for Cost reduction of SCR Installations

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Introduction

- Introduction predictive tool
- Evaluated cases:
  - Catalyst replacement
  - Cost effective NO_x removal
- Conclusions

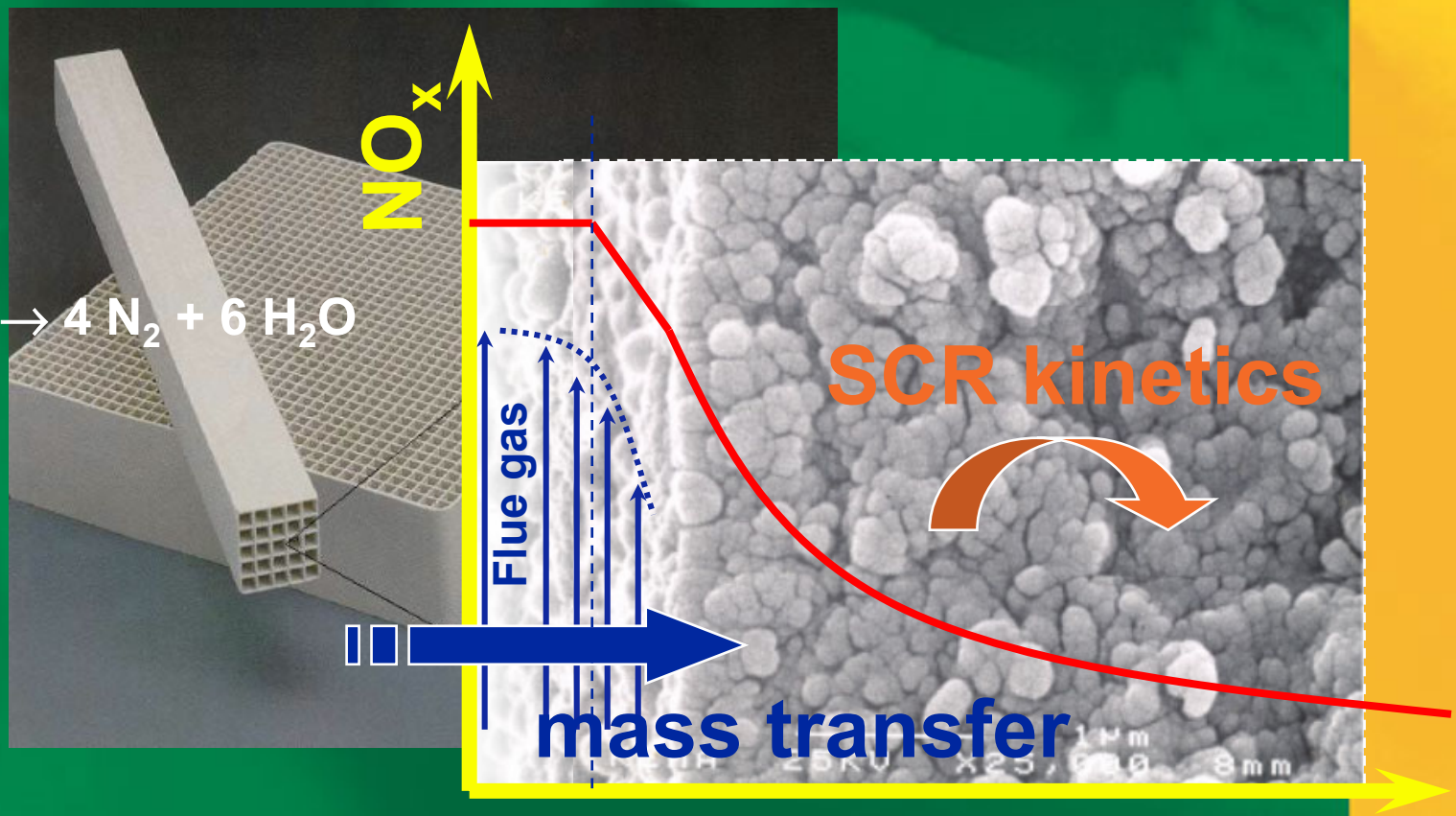
Why SCR tool ?

- solve questions:
  - process design and optimization
  - catalyst deactivation and life time prediction
  - catalyst replacement strategy

- make research results directly available:
  - reaction kinetics
  - deactivation

Fundamental principles

$4\,NO + 4\,NH_3 + O_2 \rightarrow 4\,N_2 + 6\,H_2O$



Result: a flexible tool !

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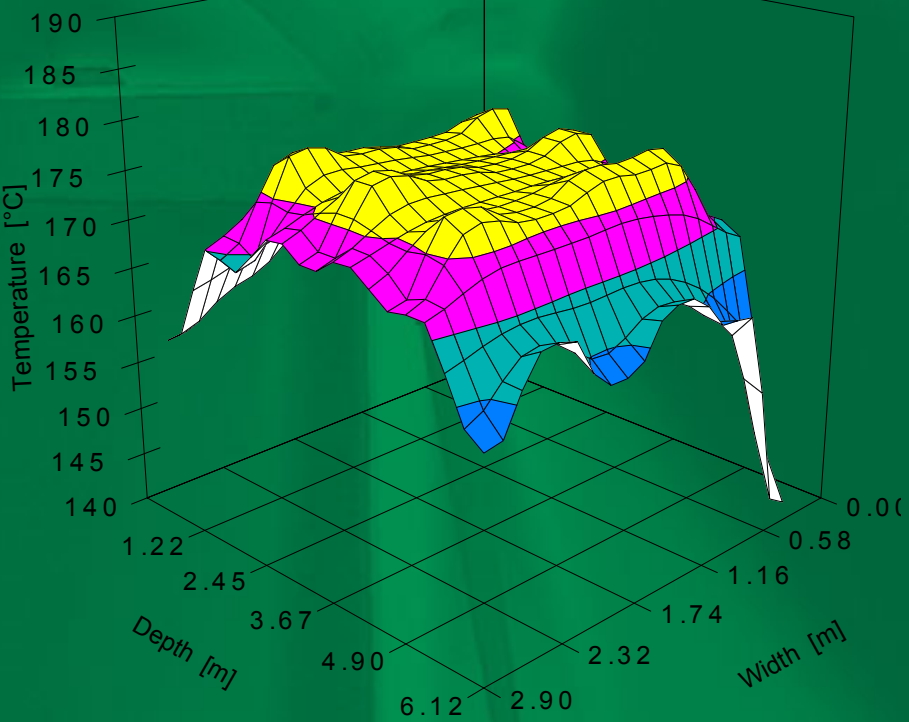
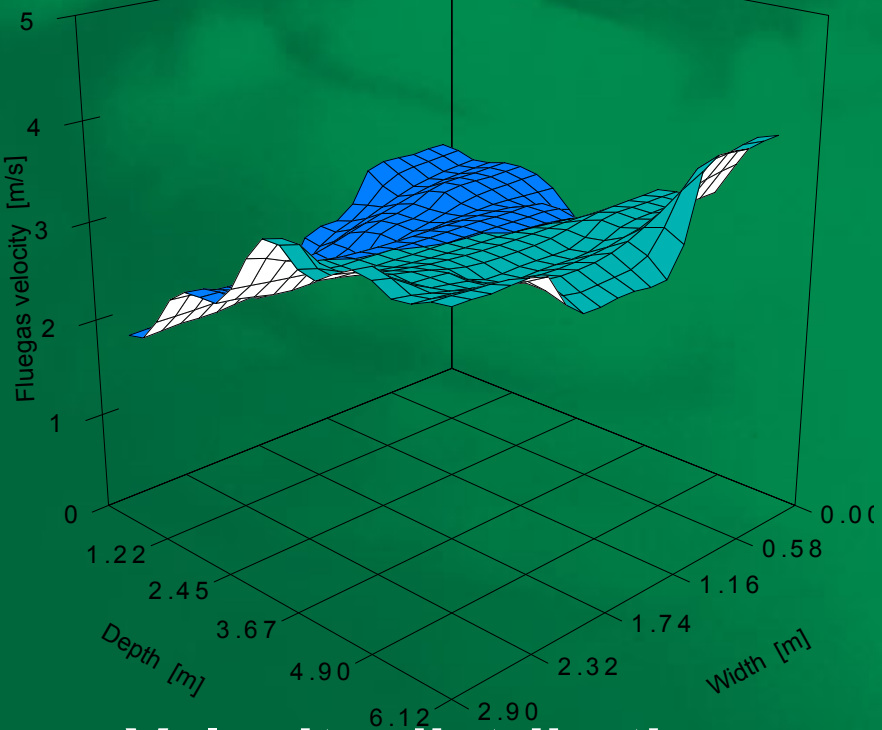
NOxVision uses installation specific information



Temperature distribution



Velocity distribution

Calculations can be made accurately

Catalysts represent a lot of money

- Up to 6 million EUR for a 600 MWe coal fired power plant
- Even at long life times (>10 years) considerable depreciations remain

increasing catalyst life time will result in interesting savings !

Catalyst Replacement

Case: high-dust SCR at coal-fired power plant

Flue gas flow	2x 960,000	m_0^3/h (dry)
Temperature	330	°C
Dust	15	g/m_0^3 (dry, [illegible])
NO_x (entrance SCR)		
[illegible]		[illegible] year
[illegible] period	15	years
(project lifetime)		
interest rate	7.5	%

Demands for catalyst replacement:

- start with first layer
- only after every 3 years period
- deactivation rate remains the same

Calculation with NOxVison

- calculate catalyst replacement
- calculate cost
  - list all cost involved
  - calculate Net Present Value (start project 2003)
  - calculate the specific NO_x cost

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Catalyst replacement

Which strategy will save most money ?

	Years in project					
Strategy	**0**	**3**	**6**	**9**	**12**	**15**
1	L1	L2	L3		L1	
2	L1	L2&L3		+L4		
3	L1	+L4		L2		
4	L1,L2&L3			+L4		
5	L1&L2		L3	+L4		
6	L1&L2		+L4		L1&-L3*	
7	L1&L2		L3&+L4			

* L3 removed to reduce pressuse drop

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Catalyst replacement, strategy 1

Catalyst replacement, strategy 3

Catalyst replacement

Which strategy will save most money ?

Conclusions catalyst replacement

- It is strongly recommended to evaluate the optimal strategy with a predictive tool
- The use of catalyst is optimised and cost minimised
- Result: interesting savings

Cost effective NO_x-removal

Possibilities to optimize SCR economics in case of NO_x trading ?

Case:

high-dust SCR at coal-fired power plant

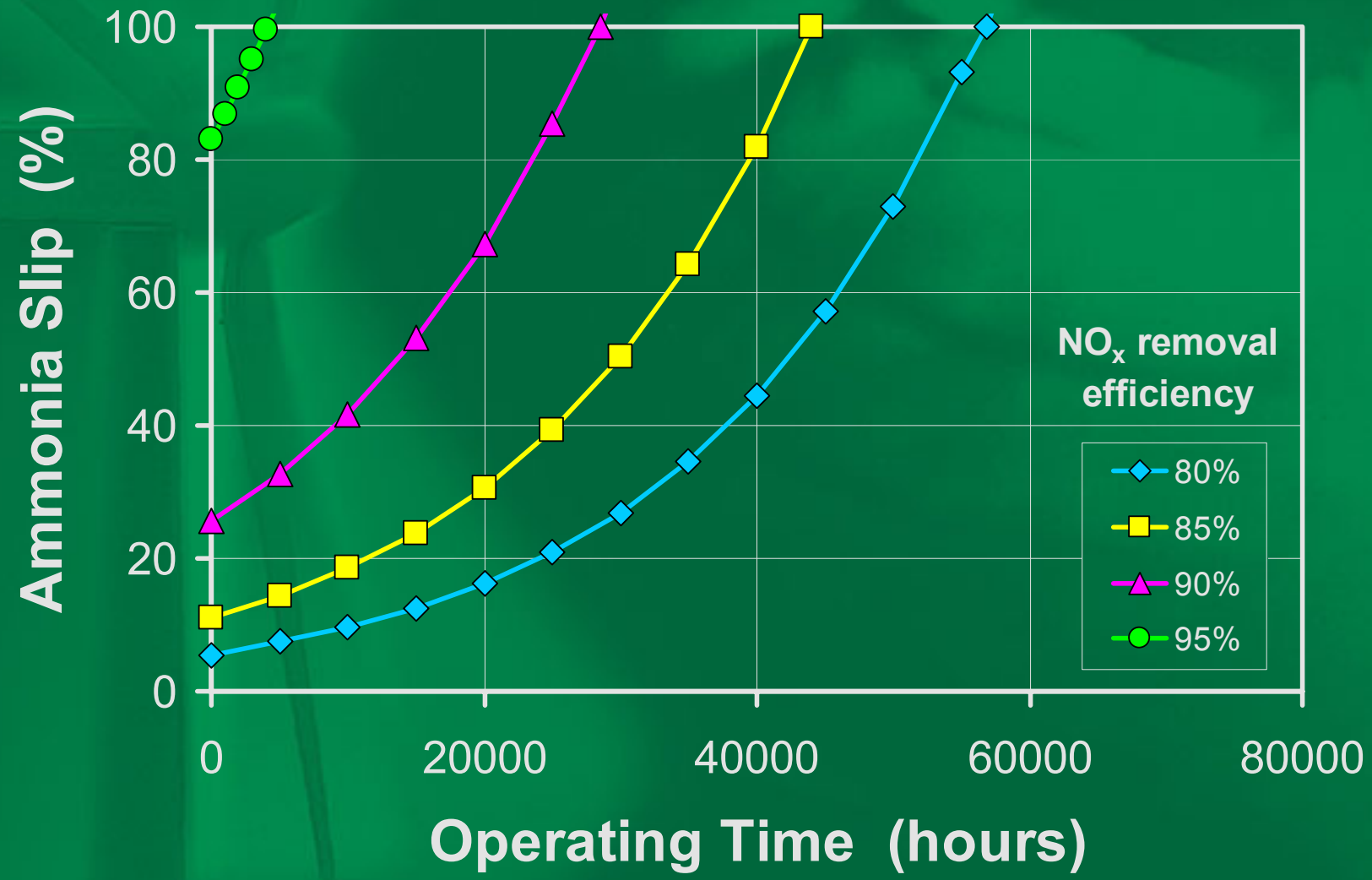
Flue gas flow	2x 1,000,000	m_0^3/h (dry)
Temperature	330	°C
Dust	13,4	g/m_0^3 (dry, 6% O_2)
NO_x (entrance SCR)	700	mg/m_0^3 (dry, 6% O_2)
SCR system	2 reactors 4 layers (last empty)	
Catalyst volume	630 (total 2 reactors)	m^3
Operating time	7,200	hours/year
Operating period (project lifetime)	15	years
interest rate	7.5	%

Cost effective NO_x-removal

Possibilities to optimize SCR economics:

- Run SCR at higher NO_x removal efficiency
- Run SCR at maximum ammonia slip

Ammonia slip at various NO_x removal rates

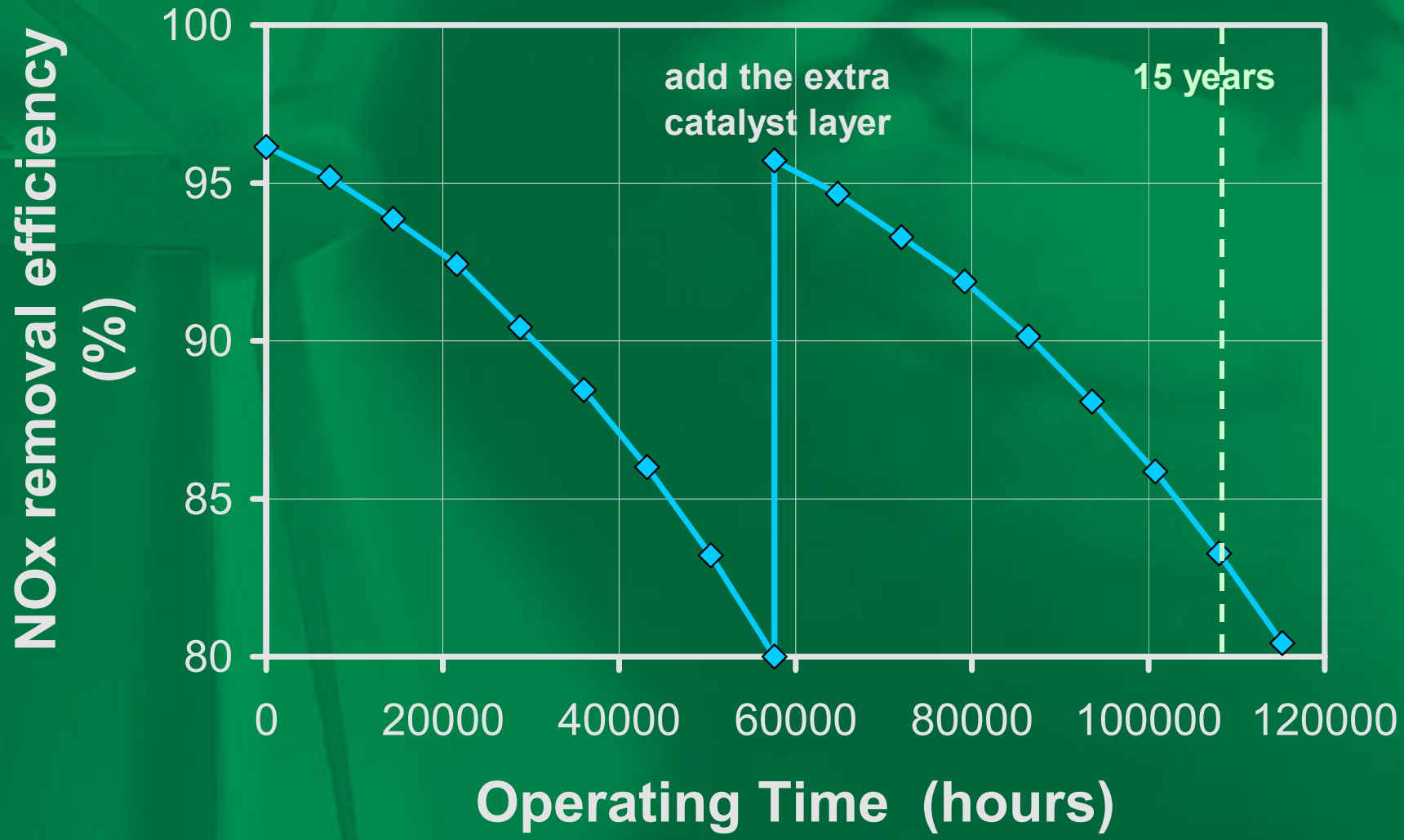


Catalyst replacement

Optimal strategies

	Years in project														
NO_x reduction	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
80%							+L4								
85%					+L4							L2			
90%			L2		+L4						L3				
95%	+L4				L2			L3		L1		L4			

SCR at maximum ammonia slip



Summary results

Cost effective NO_x-removal

	NO_x removal efficiency (%)	Extra NO_x removed (kton)	Cost NO_x (EUR/ton NO_x)
Increase set point	80	-	1353
	85	5.3	1312
	90	10.6	1290
	95	15.9	1277
maximum ammonia slip	96 - 80	10.7	1190

Conclusions
Cost effective NO_x-removal

- Ideas to improve process operation can be evaluated in advance
- The SCR can be used more cost effectively
- Result: interesting earnings (in case of NO_x trading)

Conclusions

- Operational cost of SCR systems can often be reduced
- Calculation model NOxVision has proven to be very useful and accurate in practice
  - Catalyst management
  - Cost optimization (in case of NO_x-trading)
  - Optimization flue gas flow conditions